

**National Level Exercise (NLE) 14 Waste Estimate**  
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**Summary**

The purpose of this document is to supplement the debris estimate that the Federal Emergency Management Agency (FEMA) made for the 2014 National Level Exercise (NLE) NLE-14 involving a hypothetical earthquake and tsunami scenario in Alaska and its effects on 5 municipalities (Anchorage, Homer, Seward, Kodiak, and Valdez)

The “Capstone Scenario Ground Truth” document [1] was used to initially identify the quantity of damaged infrastructure. In order to expedite the estimation process, the Waste Estimation Support Tool (WEST) tool version 2.0 [2] was used with the study areas defined by the 5 municipalities. WEST uses the Hazus-MH [3] databases to estimate affected infrastructure. The scenario ground truth document estimated that 686 single family dwellings were severely damaged or destroyed in Anchorage, which constituted roughly 1% of the single family dwellings in the study region. Therefore, the estimates for all other numbers of damaged infrastructure for all the other municipalities were based on an estimate that 1% of the structures were severely damaged or destroyed. Numbers were rounded up to 1 if this estimate resulted in less than 1 damaged structure. The only exception to this approach was for Homer, where it was explicitly stated that 70% of the residences were severely damaged or destroyed in that municipality. These numbers slightly deviate from some of the specific infrastructure listed in the Ground Truth document, but they generally agree very well.

Based on these numbers of damaged infrastructure, I-WASTE [4] was used to estimate the contents of the buildings that would likely be managed as waste. Average square footages were assumed based on I-WASTE default values. Table 1 lists the estimated numbers of damaged infrastructure of different types in the various municipalities. Table 2 lists the estimated weights of different waste categories. We were not able to assess the amount of biomass, but from looking at the overhead imagery, there was a significant amount of biomass in the study areas, and depending on damage, it may become waste.

**Table 1. Estimate of Numbers of Severely Damaged Infrastructure**

	<b>Anchorage</b>	<b>Homer</b>	<b>Seward</b>	<b>Kodiak</b>	<b>Valdez</b>
Hospital	2	1	1	1	0
Small Hotel	2	2	2	2	2
Medium Hotel	1	1	1	1	1
Large Hotel	1	1	1	1	1
Elementary School	1	0	0	0	0
Middle School	1	0	0	0	0
High School	1	0	0	0	0
Industrial	12	1	1	1	0
Medical	2	1	1	1	0
Residences	686	2491	31	15	0
Multi-Family	44	2	1	1	0
Everything	90	4	5	3	0

Else					
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**Table 2. Estimated Quantities of Waste from Municipalities (tons)**

	Anchorage	Homer	Seward	Kodiak	Valdez
Ceiling Tiles	1261	1251	1251	1251	1242
Carpet	1025	1021	1021	1021	1018
Wood Flooring	156	156	156	156	156
Curtains and Acoustical Material	0	0	0	0	0
Marble and Ceramic Tiles	118	118	118	118	118
Other Non-Structural	4444	4422	4422	4422	4400
Electronic Equipment	1987	1956	1956	1956	1925
Furniture	5683	5641	5641	5641	5599
Paper and Office Supplies	3030	3020	3020	3020	3011
Medical Supplies	9	4	4	4	0
Pharmaceuticals	1	1	1	1	0
Food	76	73	73	73	70
Linens	44	43	43	43	43
Medical Waste	0.4	0.2	0.2	0.2	0
Dishware	23	23	23	23	23
Personal Effects	833	833	833	833	833
Gym and Sports Equipment	657	657	657	657	657
Arts and Music Equipment	189	189	189	189	189
Bathroom and Kitchen Materials	1008	1008	1008	1008	1008
Vehicles*	686	2491	31	15	0
Boats**	0	1000	600	0	600
White Goods***	171.5	622.75	7.75	3.75	0

\* - assumed 1 car per destroyed residence; 2000 lb per car

\*\* - assumed 4000 lb per boat

\*\*\* - assumed 1 washer, dryer, refrigerator per destroyed residence; 500 lb total

Examining these estimates, the following observations are made:

- Medical waste does not appear to be generated in significant quantities, however, significant amounts of pharmaceuticals (on the order of a ton from each hospital) and medical supplies may need management as waste.
- Electronic equipment may constitute a significant waste stream.
- Putrescible waste (i.e., food) may be generated in quantities approaching 100 tons for each municipality.

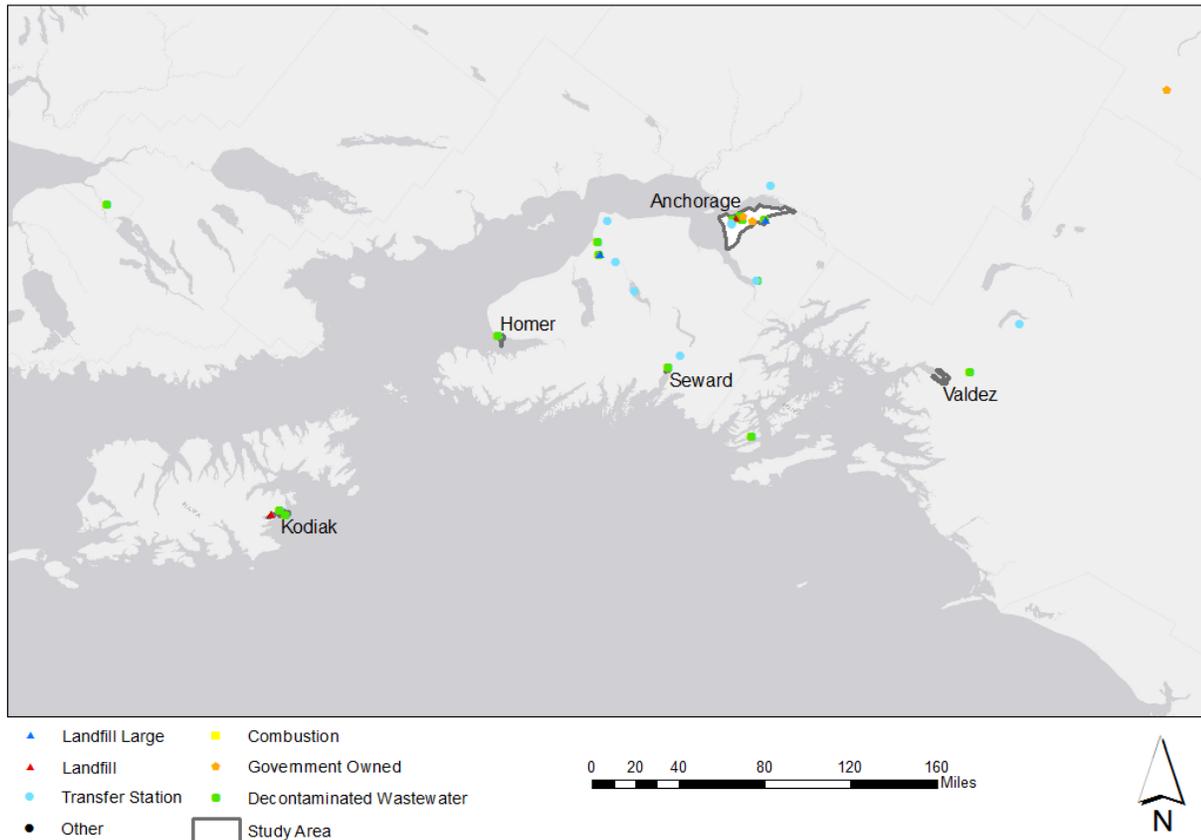
- We did not estimate biomass waste, but examining the overhead satellite imagery (See Appendix) suggests that quantities of vegetative debris could be very significant. Some of the vegetative debris will likely need to be addressed; particularly the vegetative debris interfering with port operations and maritime navigation. Limitations in availability of heavy equipment may significantly impact recovery efforts. Hurricane Katrina produced approximately 75 million cubic yards of debris, a great fraction of which was vegetative debris.

### **Potential Areas of Enhancement**

There are current limitations in estimating quantities of waste and debris from some important waste streams. In anticipation of NLE-15, the following gaps are presented for consideration to be addressed over the next year.

- Vehicles have proven to be critical components of the waste stream that present multiple challenges during the recovery efforts. Estimation of the number of vehicles is currently done in an extremely crude manner. Hazus previously provided vehicle estimates, but this functionality has been removed. It is suggested that a similar functionality be restored to Hazus.
- There is not an immediately available method to estimate the numbers of orphan tanks. It might be possible to make an estimate by compiling data of household usage of above-ground tanks and gas grills, coupled with business (particularly gas stations) usage of above ground tanks.
- Alaska does not have a RCRA Subtitle C disposal facility to handle hazardous waste. Affected industrial facilities as well as port operations may generate significant quantities of hazardous waste that would need to be transported long distances for treatment/disposal. Figure 1 shows a map of potential waste treatment/disposal/handling facilities in the vicinity of the incident.

Capstone National Level Exercise 2014 - I-WASTE Layers



**Figure 1. Waste Management Facilities in the Incident Locale**

- Identification of the numbers and potential locations of radioactive sources in the affected area should be done as soon as possible. Sources would be registered with the State or NRC; contact State radiation control program to locate potential sources.
- According to the Ground Truth document, a significant number of transformers will be damaged and require replacement. Some of them may contain PCBs. This is a potentially important waste stream that has specific requirements associated with its management.
- Identifying and managing mold-contaminated waste may help to eliminate a potentially significant public health concern.
- Incidents such as this scenario, where oil production and transportation facilities are affected, can result in a significant quantity of oil-soaked waste and debris. This debris may present waste management challenges, where facilities that accepted similar wastes prior to the incident may resist accepting incident-derived waste. It may be possible to develop a methodology to estimate quantities of oil-soaked waste by analyzing data from previous spills and disasters.
- A potential major issue exists where future waste management capacity may be reduced due to wastes being produced during rebuilding operations as previously damaged materials enter the waste stream.

- Transportation limitations associated with the remoteness of Alaska in general may present creative opportunities for recycling of some of the waste and debris (potentially significant fractions) that may not be economically favorable in more populated sections of the country.

## References

1. FEMA, National Exercise Program, Capstone Exercise 2014, Scenario Ground Truth, DRAFT 19, Feb 2014.
2. Boe, T., P. Lemieux, D. Schultheisz, T. Peake, and C. Hayes, *A Planning Tool for Estimating Waste Generated by a Radiological Incident and Subsequent Decontamination Efforts*, in *Waste Management 2013 Conference* 2013: Phoenix, AZ.
3. FEMA. *HAZUS-MH Version 1.4*. 2010 [accessed 2010 October 14]; Available from: <http://www.fema.gov/plan/prevent/hazus/>.
4. U.S. EPA, Incident Waste Decision Support Tool (I-WASTE), v.6.3 Project Report, EPA/600/R-13/160, 2013.

**APPENDIX**

Following are the estimated waste distributions, study regions, and overhead satellite imagery for the various municipalities.

**Anchorage**

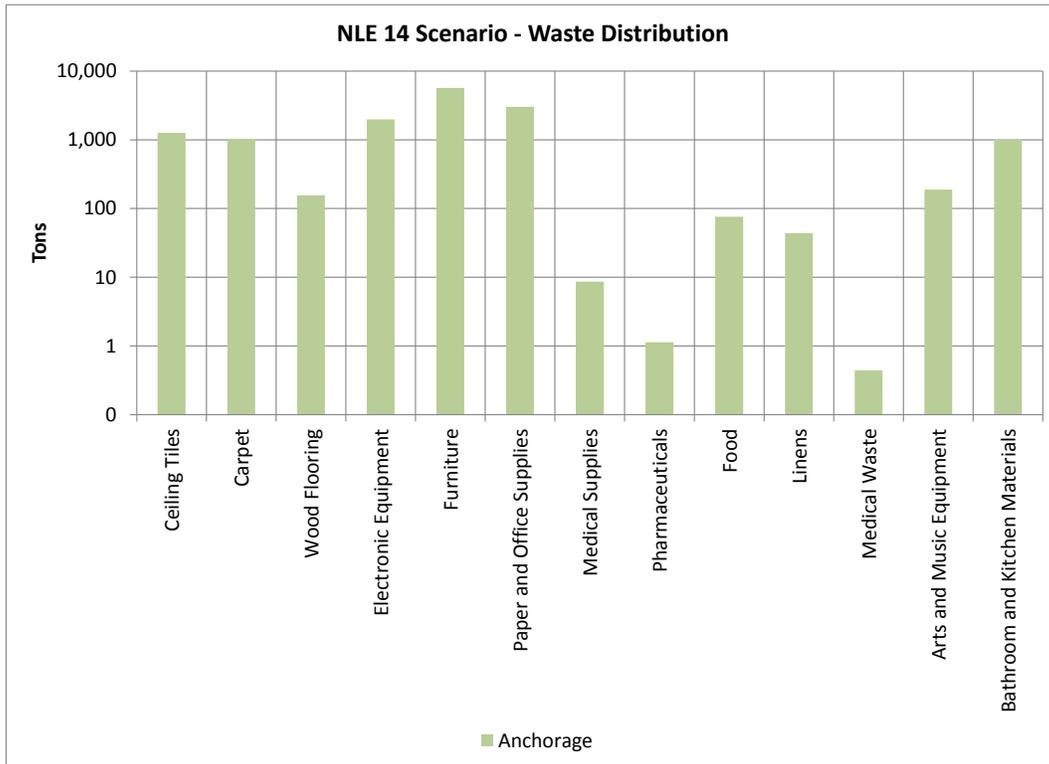


Figure A-1. Distribution of Waste Estimate for Anchorage



Figure A-2. Overhead Satellite Image of Anchorage Earthquake Study Area

# Capstone Exercise 2014 - Anchorage

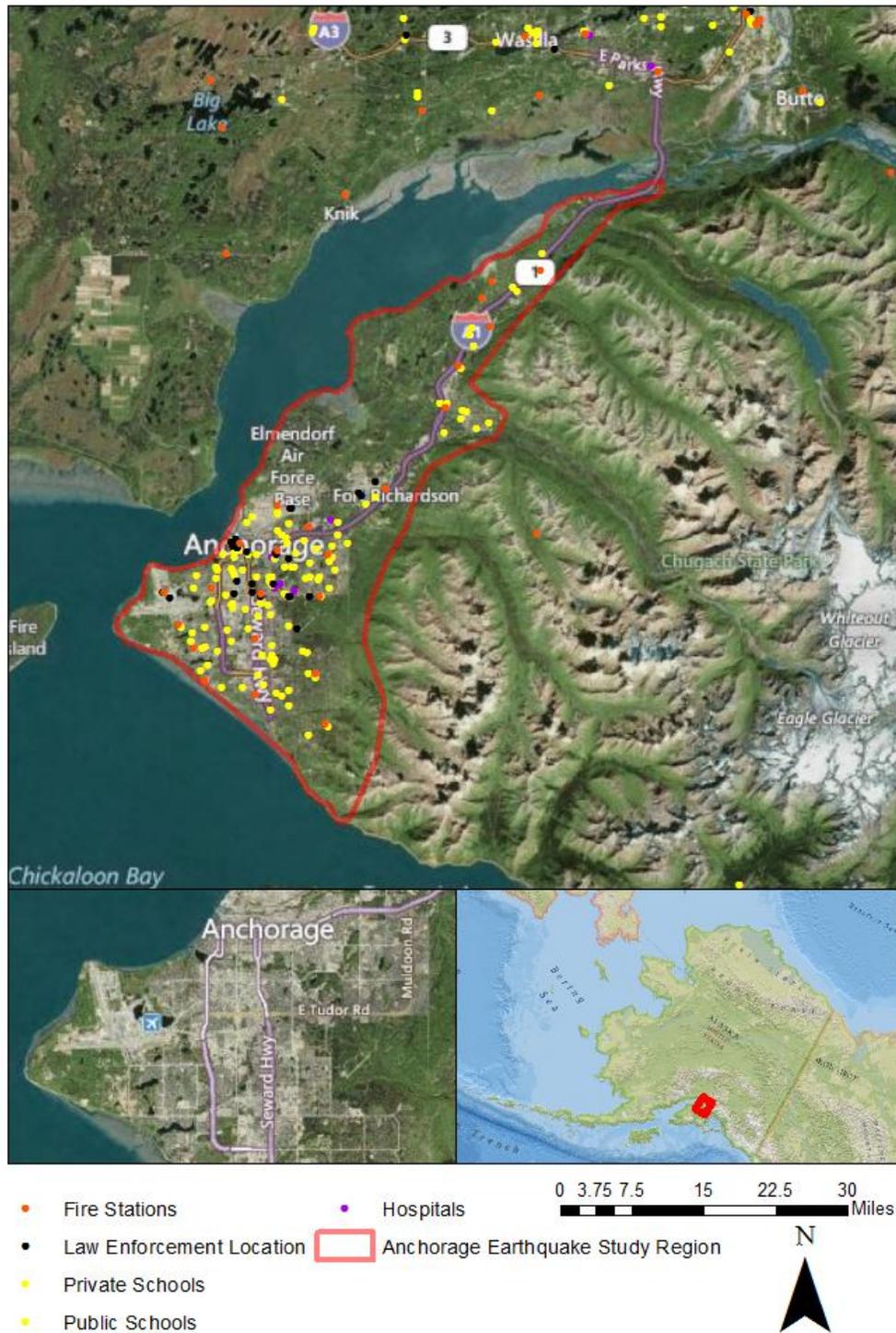


Figure A-3. Illustration of Police Stations, Schools, and Hospitals in Anchorage Study Region

### Homer

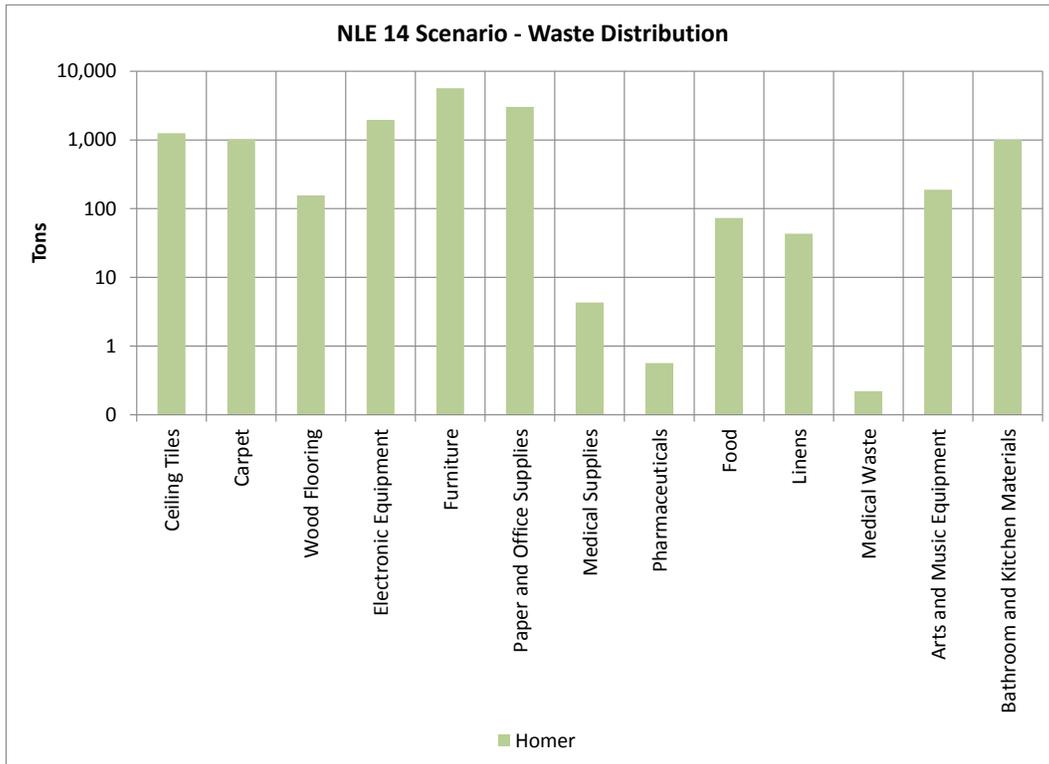


Figure A-4. Distribution of Waste Estimate for Homer



Figure A-5. Overhead Satellite Image of Homer Earthquake Study Area

# Capstone Exercise 2014 - Homer

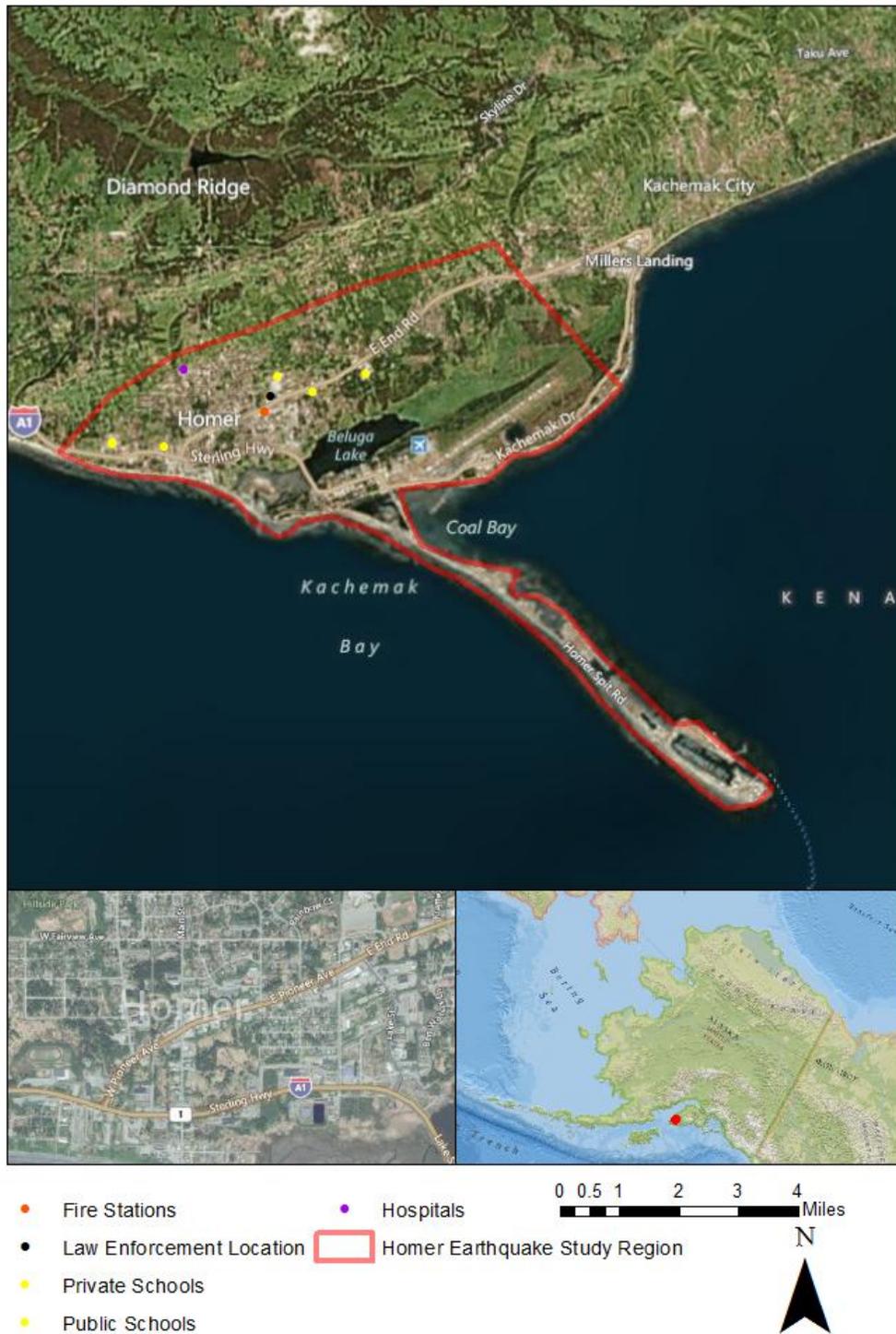


Figure A-6. Illustration of Police Stations, Schools, and Hospitals in Homer Study Region

### Seward

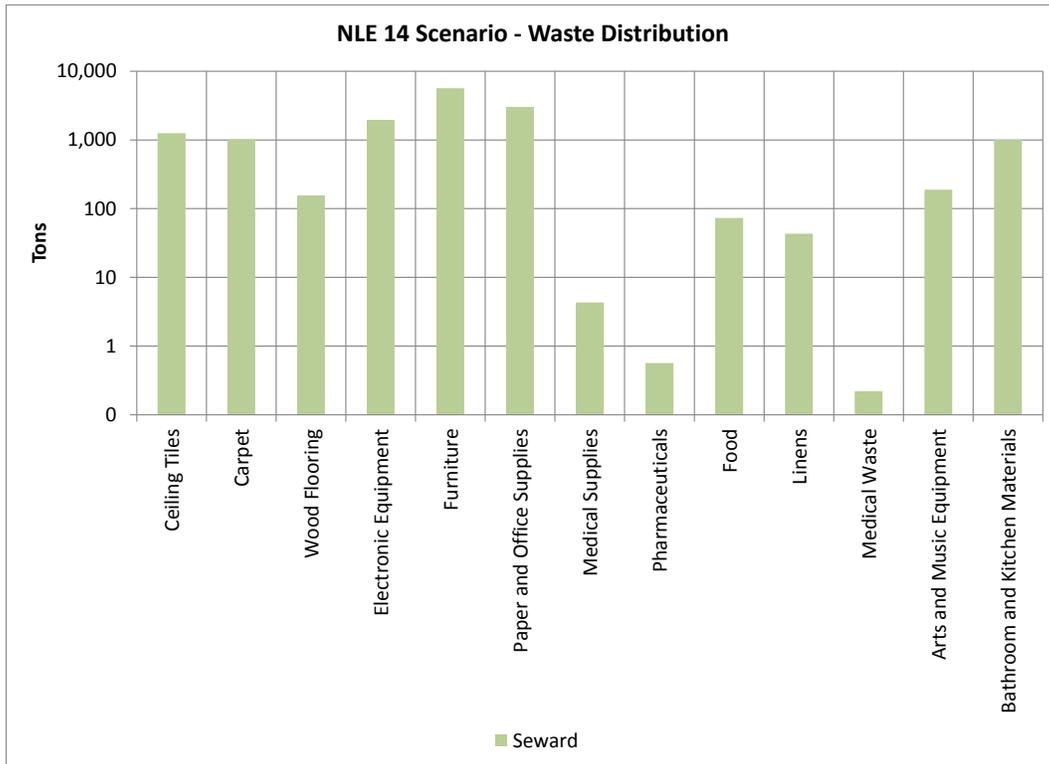


Figure A-7. Distribution of Waste Estimate for Seward



Figure A-8. Overhead Satellite Image of Seward Earthquake Study Area

# Capstone Exercise 2014 - Seward

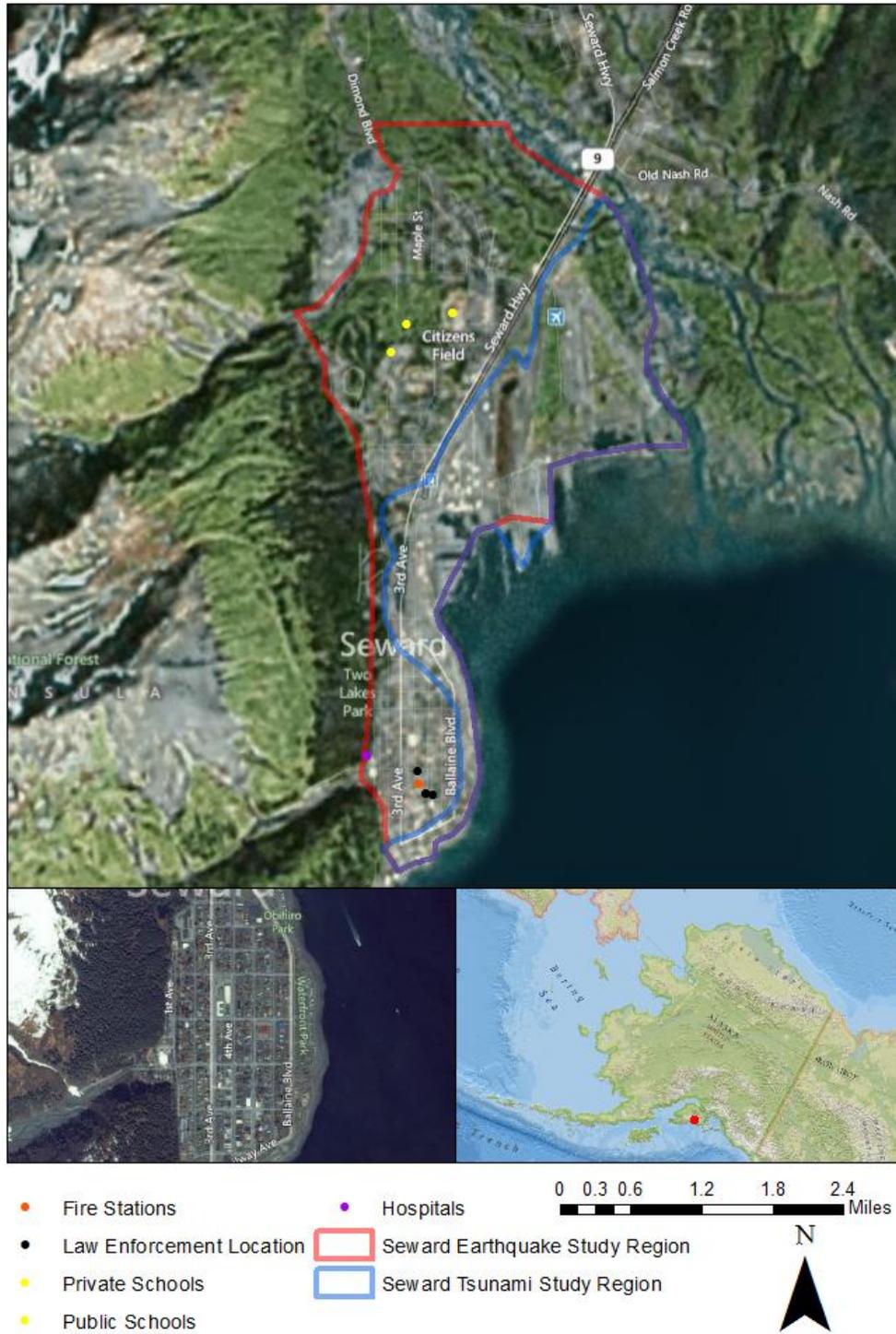


Figure A-9. Illustration of Police Stations, Schools, and Hospitals in Seward Study Region

### Kodiak

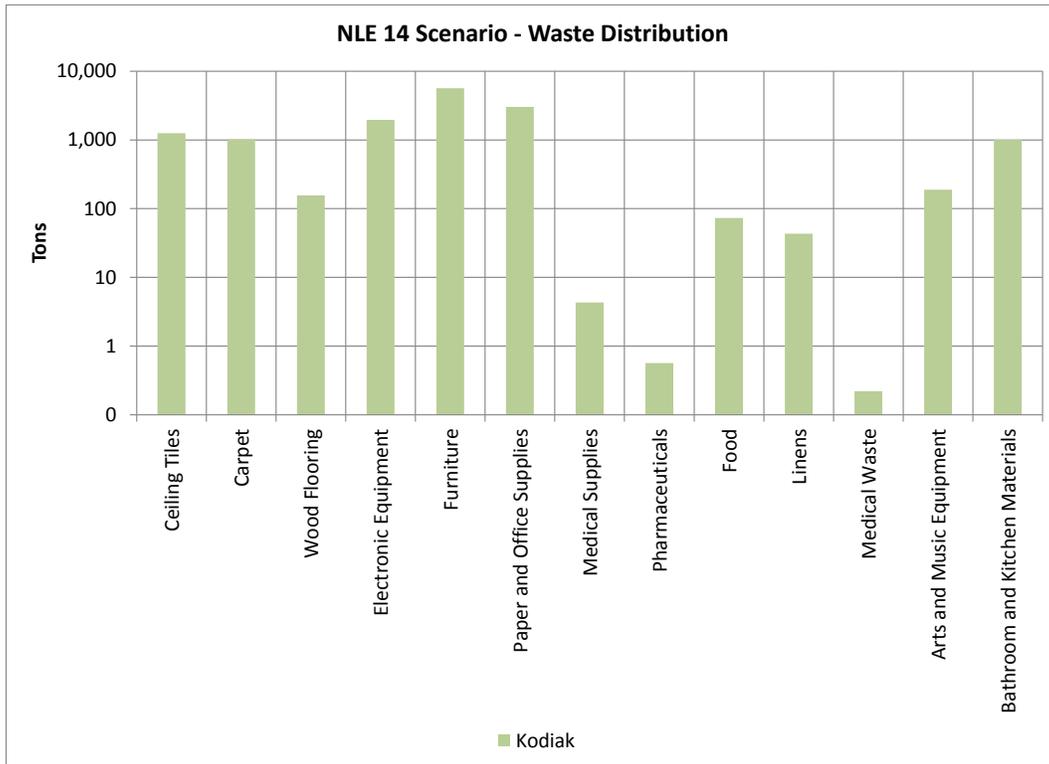


Figure A-10. Distribution of Waste Estimate for Kodiak

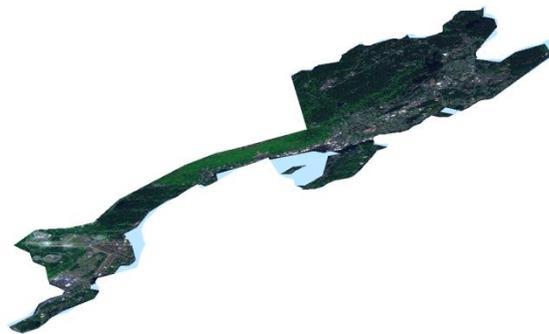


Figure A-11. Overhead Satellite Image of Kodiak Earthquake Study Area

# Capstone Exercise 2014 - Kodiak



Figure A-12. Illustration of Police Stations, Schools, and Hospitals in Kodiak Study Region

### Valdez

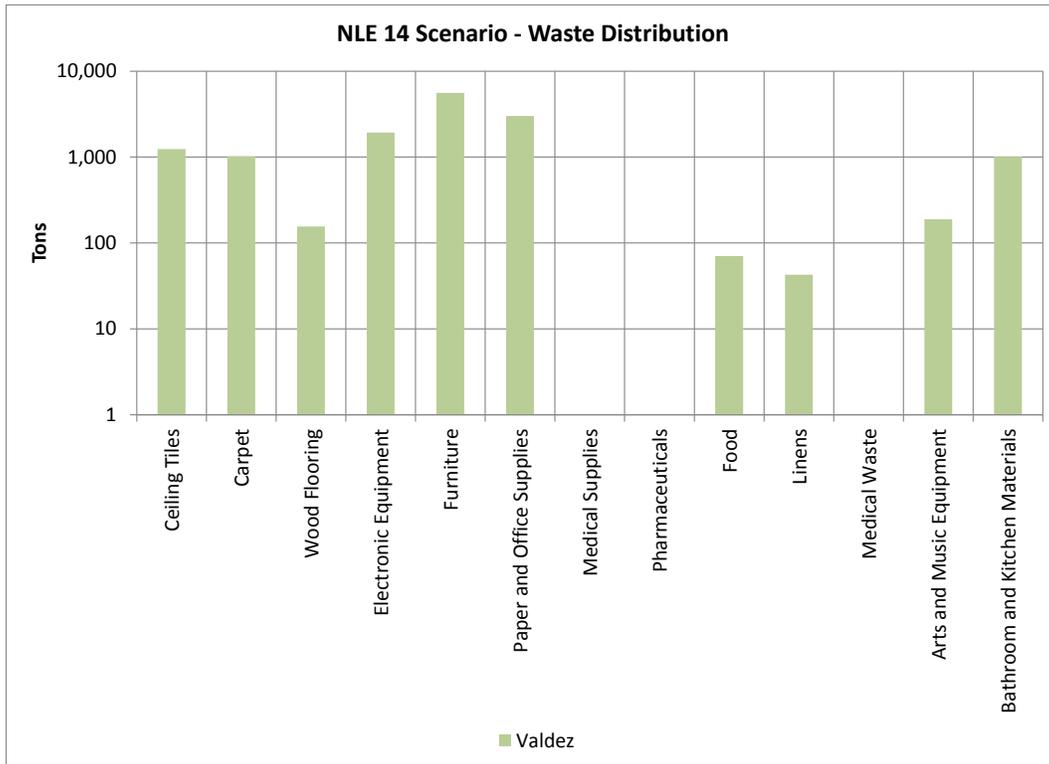


Figure A-13. Distribution of Waste Estimate for Valdez

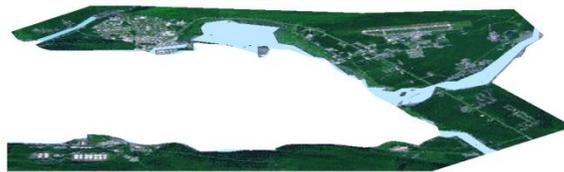


Figure A-14. Overhead Satellite Image of Valdez Earthquake Study Area

# Capstone Exercise 2014 - Valdez



Figure A-15. Illustration of Police Stations, Schools, and Hospitals in Valdez Study Region